

CLAIMS

1. In a process for increasing a relative humidity in an enclosed space from a first relative humidity to a target relative humidity by increasing the relative humidity in a plurality of graduated steps.
2. A process for humidifying an atmosphere in a sterilization chamber to a target relative humidity, the process comprising the steps of
 - a) providing an amount of water in a water reservoir at a temperature T_s at or above a temperature of the chamber atmosphere T_c ;
 - b) reducing a pressure in the chamber to a value below the boiling point of water at the reservoir temperature T_s ;
 - c) bringing the reservoir into fluid communication with the chamber for exposing the water in the reservoir to the reduced pressure in the chamber for a preselected exposure time so that water in the reservoir is boiled and to allow resulting water vapour to enter the chamber;and repeating at least steps b) and c) a plurality of times, wherein at least one of the amount of water and the exposure time are controlled such that the relative humidity in the chamber progressively increases with each repetition until the target humidity is reached.
3. A method according to claim 2 wherein the chamber and the reservoir are in fluid communication by means of a conduit having a valve to open and close the conduit.
4. A method according to claim 2 wherein after each step c) the conduit is closed for a time sufficient to adjust the temperature T_s or T_c of the reservoir or chamber so that T_s is equal to or above the temperature T_c of the chamber.
5. A method according to claim 2 wherein steps b) and c) are repeated from 3 to 30 times.

6. A method according to claim 2 wherein steps b) and c) are repeated from 5 to 27 times.
7. A method according to claim 2 wherein steps b) and c) are repeated at least 10 times and for each of the last 10 times the water vapour pressure in the chamber is increased by an amount in the range of from 0.01 to 5 Torr.
8. A method according to claim 2 wherein steps b) and c) are repeated at least 5 times and for each of the last 5 times the water vapour pressure in the chamber is increased by an amount in the range of from 0.01 to 3 Torr.
9. A method according to claim 2 wherein steps b) and c) are repeated at least 3 times and for each of the last 3 times the water vapour pressure in the chamber is increased by an amount in the range of from 0.25 to 1 Torr.
10. A method according to claim 2 wherein the temperature of the water in the reservoir is maintained from 0 to 10°C above the temperature of the chamber.
11. A method according to claim 2 wherein the temperature of the water in the reservoir is maintained from 0 to 7°C above the temperature of the chamber.
12. A method according to claim 2 wherein the temperature of the water in the reservoir is maintained from 0 to 3°C above the temperature of the chamber.
13. A method according to claim 2 wherein the first time steps b) and c) are effected, the relative humidity in the chamber is increased to no more than 80% of the target relative humidity.

14. A method according to claim 2 wherein the first time steps b) and c) are effected, the relative humidity in the chamber is increased to no more than 60% of the target relative humidity.

15. A method according to claim 2 or 4 wherein the number of times steps b) and c) are repeated and the increase in the relative humidity in the chamber after each step b) is selected to avoid substantially any condensation in the chamber.

16. A method of humidifying an enclosed space to a target relative humidity, the method comprising a plurality of humidification stages $S^x \dots S^n$, wherein x is an integer from 1 to n and each x represents an individual stage, each said stage having a corresponding water vapour pressure $h_x \dots h_n$, and h_u representing the water vapour pressure corresponding to the target relative humidity, each said stage S_x including the steps of a) supplying water vapour from a water vapour source to the enclosed space to increase the water vapour pressure in the space to at least the value h_x corresponding to said stage S_x , b) disconnecting the source from the space for a preselected equilibration period, and c) repeating steps a) and b) until said water vapour pressure h_n is reached in the space.

17. A method according to claim 16 wherein the water vapour source is a water reservoir, the temperature of the water vapour source is T_s , the temperature of the space is T_c , for each said stage S_x there is a corresponding temperature differential value ΔT_x which is represented by an equation $T_s - T_c = \Delta T$ wherein T_s is the same, or higher than, T_c so that $\Delta T_x \geq 0$ and step b) comprises disconnecting the source from the space for a time sufficient to adjust T_s or T_c to achieve the value for ΔT_x .

18. A method according to claim 16 wherein n is from 3 to 30.

19. A method according to claim 16 wherein n is from 5 to 27.

20. A method according to claim 16 wherein n is greater than 10 and for each stage S_x of the last 10 stages, from $n-10$ to n , each increase in water vapour pressure from the previous stage S_{x-1} to the stage S_x , said increase represented by $h_x - h_{x-1}$, is in the range of from 0.01 to 5 Torr.
21. A method according to claim 16 wherein n is greater than 5 and for each stage S_x of the last 5 stages, from $n-5$ to n , each increase in water vapour pressure from the previous stage S_{x-1} to the stage S_x , said increase represented by $h_x - h_{x-1}$, is in the range of from 0.01 to 3 Torr.
22. A method according to claim 16 wherein n is greater than 3 and for each stage S_x of the last 3 stages, from $n-3$ to n , each increase in water vapour pressure from the previous stage S_{x-1} to the stage S_x , said increase represented by $h_x - h_{x-1}$, is in the range of from 0.25 to 1 Torr.
23. A method according to claim 16 wherein the value of h_1 for the first stage represents a relative humidity of no more than 80% of the target value.
24. A method according to claim 16 wherein the value of h_1 for the first stage represents a relative humidity of no more than 60% of the target value.
25. A method according to claim 16 wherein said space is sterilization chamber for a humidified ozone sterilization process.
26. A method according to claim 16 wherein the number of stages and the corresponding water vapour pressure values are selected to avoid substantially any condensation in said space.
27. An apparatus for sterilization with humidified ozone, the apparatus comprising a sterilization chamber,

a reservoir to hold water while in operation, to provide a source of water vapour to humidify the ozone,

a conduit in fluid communication between the reservoir and the sterilization chamber,

a valve in the conduit to open and close the conduit,

a first heating means to control the temperature of the chamber,

a second heating means to control the temperature of the reservoir,

a first temperature sensing means to monitor the temperature of the sterilization chamber,

a second temperature sensing means to monitor the temperature of the reservoir,

a pressure sensing means to monitor the pressure in the chamber,

vacuum means to reduce the pressure in the chamber,

a processor to control the first and second heating means in response to information from the first and second temperature sensing means and the pressure sensing means,

wherein the processor is programmed to effect a humidification of the sterilization chamber in a plurality of stages.

28. An apparatus according to claim 27 wherein said plurality of stages is from 3 to 30.

29. An apparatus according to claim 27 wherein said plurality of stages is from 5 to 27.

30. An apparatus according to claim 27 wherein said plurality of stages is greater than 10 and the processor is programmed to effect a water vapour pressure increase in each of the last 10 stages in the range of from 0.01 to 5 Torr.

31. An apparatus according to claim 27 wherein said plurality of stages is greater than 5 and the processor is programmed to effect a water vapour pressure increase in each of the last 5 stages in the range of from 0.01 to 3 Torr.

32. An apparatus according to claim 27 wherein said plurality of stages is greater than 3 and the processor is programmed to effect a water vapour pressure increase in each of the last 3 stages in the range of from 0.25 to 1 Torr.
33. An apparatus according to claim 27 wherein the processor is programmed to maintain the temperature of the reservoir at or above the temperature of the chamber.
34. An apparatus according to claim 27 wherein the processor is programmed to maintain the temperature of the reservoir form 0 to 7°C above the temperature of the chamber.
35. An apparatus according to claim 27 wherein the processor is programmed to maintain the temperature of the reservoir form 0 to 3°C above the temperature of the chamber.